Experiment:

	20 poker chips.	n=	15
Claim:	10 red chip, rest blue	p=	0.5
	15 trials		

RED	BLUE
II	卌 卌 III

$\hat{p} = 0.133$

Given the info above, what's the chance of getting our experimental result or something more extreme?

P($\hat{p}$ < .133) = normalcdf(-e99, 0.133, 0.5, $\sqrt{\frac{(0.5)(0.5)}{15}}$) = 0.0022 Do you think the claim is true? Why?

	20 poker chips.	
Claim:	5 red chip, rest blue	
	15 trials	

$n = 15$

$p = 0.25$

RED	BLUE
||	卌 卌 |||

$\hat{p} = \frac{2}{15} = 0.133$

Given the info above, what's the chance of getting our experimental result or something more extreme?

P($\hat{p} < 0.133$) = normcdf$\left(-E99, 0.133, 0.25, \sqrt{\frac{(0.25)(0.75)}{15}}\right) = 0.1476$ Do you think the claim is true? Why?

AP Statistics Section 8.1- Hypothesis Tests

$\hat{p} = \frac{3}{15}$

TESTS OF SIGNIFICANCE

Uses/Purposes:

1. What are these tests used for?

- To assess...

- evidence for/against a claim from a sample.
- evidence = prob

- testing a claim
- given a claim
- take a sample
- decide whether claim is T/F

2. What do these tests compare?

Samples/data to hypothesis (claim)

0.55

claim = 0.5

$\frac{8}{15}$

3. *How are the results of these tests expressed?*

probability of how well data agrees w/ hypothesis

4. *What are the results a probability of?*

getting our sample (or something more extreme) if claim is true

5. *What are the ~~4~~ 5 components of a Test of Significance?*

a. Assumptions (state + check)

b. Hypotheses

c. Test Statistic

d. P-value (probability)

e. Conclusion

In Ch. 8, we will be looking at testing a population proportion ($\hat{p}$)

Ch. 7 - μ

Components:

1. *Hypotheses*

What do the hypotheses always describe?

population

What types of symbols do the hypotheses always use?

parameters

Name: ***Null Hypothesis***

Symbol: H_0:

What is it?

- claimed value
- known/believed value

FORM: H_0: parameter = value

Example:

$H_0: p = 0.5$

If the null hypothesis is true, what do we expect from the estimate?

estimate/sample ≈ parameter

Name: ***Alternative Hypothesis***

Symbol: Ha :

What is it?

- what we/you believe is true
- what you're hoping to find evidence for

FORM: Ha : parameter $>$ $<$ $\neq$ ___value___

Two types of alternative hypotheses:

one sided: $>$, $<$

two sided: $\neq$

Examples:

Ha: $p < 0.5$

Ha: $\mu > 65$

Ha: $p \neq 0.25$

2. *Tests Statistic*

What does the test statistic measure?

compatability btw H_0 (claim) + data

What is this test statistic used for?

prob. calculation

What type of a variable is this test statistic and what type of distribution does it have?

Z-score $N(0,1)$

Formula (for the test statistic of a population proportion):

$$Z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}}$$

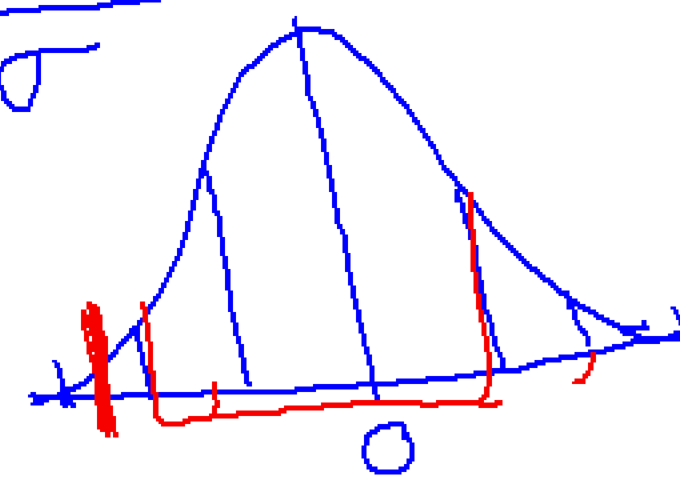
$$Z = \frac{x - \mu}{\sigma}$$

Example:

$\hat{p} = \frac{2}{15}$

$p = 0.5$

$$Z = \frac{0.133 - 0.5}{\sqrt{\frac{(0.5)(0.5)}{15}}} = -2.84$$



3. P-Value (prob)

Definition:

prob. of getting our sample or something more extreme) if claim is true
H_0

The smaller the p-value...

the more evidence against claim
H_0

What is true about our evidence as the sample proportion ($\hat{p}$) gets further from the population proportion (p)?

evidence gets stronger against H_0.

How do we use the test statistic to find the P-Value? What distribution do we use?

use normalcdf $N(0,1)$

$P(z \geq \underline{\text{test stat}})$

Ex: $P(z < -2.84) = \text{normcdf}(-E99, -2.84, 0, 1) = 0.0022$

4. *Conclusion*

Statistical Significance

Definition: result that happens so often (or so rarely) that it's not just chance

What does statistical significance compare?

p-value to a fixed level (significance level)

What is a significance level? What symbol do we use to denote this level?

α

fixed value when we believe/don't believe claim

α = alpha = significance level

What does a significance level of 0.05 or 0.01 indicate about the null hypothesis?

$\alpha =$ 0.01, 0.05, 0.10 } given

If a significance level is not given, what level do we use?

$\alpha = 0.05$

Conclusions: = 2 sentences

$H_0: p =$ ___

$H_a: p \gtrless \neq$ ___

What are the two conclusions that we can have (be careful how they are stated!)

- We reject Ho in favor of Ha, b/c p-value < α.
  We have sufficient evidence that the prop of (context) is $\gtrless \neq$ value.
- We fail to reject Ho b/c p-value > α.
  (not accept)
  We have suff. evid. that the prop of context is = to value.

* innocent vs. not guilty

Our conclusion must always be a complete sentences *in terms of* Ho.

Tests of Significance *Example:*

Go back to the alcohol abuse example. The National Board of Statistics claims that **over** 15% of college students are classified as binge drinkers. Remember, there was an SRS of 17096 college students and found 3314 were classified as binge drinkers. Is there evidence to support the Board of Statistic's claim? Use $\alpha = 0.05$.

$n = 17096$
$x = 3314$
$\alpha = 0.05$

STATE
1. SRS
2. np, $n(1-p) \geq 10$
3. pop $\geq 10 \cdot n$

CHECK
1. circled
2. $(17096)(0.15)$, $(17096)(0.85) \geq 10$ ✓
3. pop $\geq 10(17096)$ ✓

1. Hypotheses:

   Ho: $p = 0.15$

   Ha: $p > 0.15$

2. Test Statistic:

$$z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} = \frac{\left(\frac{3314}{17096}\right) - 0.15}{\sqrt{\frac{(0.15)(0.85)}{17096}}} \approx 16.056$$

3. P-Value:

$$P(z > 16.056) = 2.756 \times 10^{-58}$$

4. Conclusion:

We reject Ho in favor of Ha b/c p-val < $\alpha = 0.05$.
We have suff. evid. that prop. of binge drinkers is greater than 15%.

AP Stat Tests of Significance- 2 sided

The proportion of people who are afraid of flying is claimed by the FAA to only be 35%. You do not believe this, and take a sample of 145 random adults and find that 70 of them are afraid of flying. Perform a statistical test of significance on the claim at the 0.05 significance level.

Assump

$n = 145$

$x = 70$

$\alpha = 0.05$

$\hat{p} = \frac{70}{145}$

(a) State the hypotheses

$H_0: p = 0.35$

$H_a: p \neq 0.35$

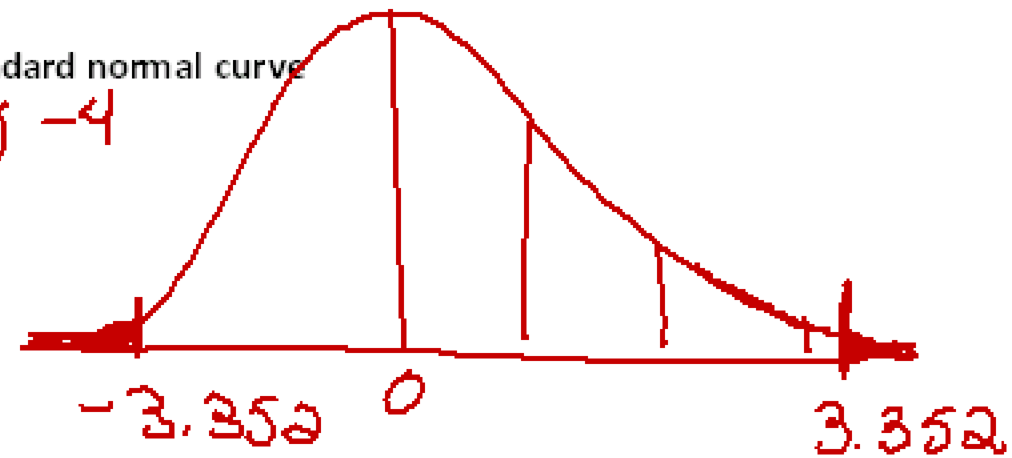
(b) Find the test statistic

$$z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} = 3.352$$

(c) Find the P-value, and sketch a picture of the P-value on a standard normal curve

$$2 \cdot P(z > 3.352) = 8.035 \times 10^{-4}$$

$$2 \cdot P(z < -3.352)$$



(d) Report your conclusion at the $\alpha = 0.05$ level.

- reject Ho

- suff. evid $p \neq 0.35$

p-val = 0.02

(e) Report your conclusion at the $\alpha = 0.01$ level.

– Same

b/c p-val < 0.01

(f) Create a 95% confidence interval for the population proportion and interpret

$$\hat{p} \pm z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = (0.4014, 0.5641)$$

We are 95% conf. that the prop. of people afraid to fly is btw. 40.14% & 56.41%

Complete the following worksheet
Section 8.1 - Hypothesis Testing

14

$p = 0.384$

$X = 25$

$n = 40$

$\hat{p} = \frac{25}{40}$

ⓐ $H_0: p = 0.384$

$H_a: p > 0.384$

ⓑ $z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} = \frac{\left(\frac{25}{40}\right) - 0.384}{\sqrt{\frac{(0.384)(1-0.384)}{40}}} = 3.134$

p-value small

$P(z > 3.134) = 8.623 \times 10^{-4}$

We reject Ho in favor of Ha b/c p-value $< \alpha = 0.05$.
We have suff. evid that the prop. of free throws made is greater than 0.384.

ⓔ Assump

STATE

① SRS

② np, $n(1-p) \geq 10$

③ $pop \geq 10 \cdot n$

CHECK

① assumed

② $(40)(0.384) \geq 10$ ✓
$(40)(1-0.384)$ ✓

③ $pop \geq (10)(40)$ ✓

(d) $\hat{p} \pm z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ no $H_0: p =$

$= (0.5, 0.75)$

$x = 25$
$n = 40$
$C = 90\%$
$= 0.90$
95%

We are 90% conf. that the prop of free throws made is btw 50% & 75%

Calc/Form Sheet

Conf. Int: CALC: STAT → TESTS → 1 Prop Z-Int

Form sheet: statistic ± (crit val)(Std. dev of stat)

tables below

Tests: Form Sheet: $\dfrac{\text{statistic} - \text{param}}{(\text{std. dev of stat})}$

Calc:

$$\frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} \qquad \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$